

Costs of Treating Lower Respiratory Tract Infections in Outpatients

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Objective: To determine the direct medical costs of treating lower respiratory tract infections (LRTIs) in a managed care organization (MCO).

Study Design: Retrospective analysis of a regional MCO identifying adults diagnosed with acute exacerbation of chronic bronchitis (AECB) or community-acquired pneumonia (CAP).

Methods: A claims database examination of *International Classification of Diseases, Ninth Revision, Clinical Modification* codes was conducted to identify adults receiving initial outpatient care for an LRTI during 2005-2006. Medical record review then was conducted to verify clinical diagnosis of AECB or CAP. Clinical and demographic data were collected. Outpatient office and clinic visits, hospitalization, and radiology, pathology, and pharmacy records were used to determine treatment costs. Treatment failure was determined by use of a second antibiotic course, follow-up emergency room presentation, or hospitalization for LRTI within 28 days of the index visit. The primary outcome was per-case treatment cost from the payer perspective.

Results: Clinical diagnosis was confirmed for 65 unique coded visits (60 patients; 39 with AECB, 22 with CAP; 1 in both cohorts). Initial visit, initial diagnostic testing, and subsequent hospitalization accounted for the majority (63%) of payer costs. Antibiotics were responsible for 15% of payer costs. Higher initial antibiotic expenditure in the AECB cohort yielded a cost-benefit ratio of 3:1. Mean per-case costs for success and failure were \$277 & \$372 for AECB, and \$493 & \$3019 for CAP, respectively.

Conclusions: Initial visit and hospitalization costs contribute the majority of payer expenditure while antibiotic expenditure incurs a nominal burden. Higher expenditure on initial antibiotic therapy in the AECB population appears to be beneficial.

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For author information and disclosures, see end of text.

Epidemiological data from the 1980 National Medical Care Utilization and Expenditure Survey indicated that acute respiratory tract infections were responsible for approximately 5% of the total charges for all healthcare services in the United States.¹ Lower respiratory tract infection (LRTI) occurred in only 4% of the population (vs 50% for upper respiratory tract infection), yet was responsible for 42% of the economic burden for acute respiratory tract infection. These charges were primarily attributable to hospitalization (74.1%), followed by physician visits (21.4%) and medications (2.7%).¹ Previous analyses identifying hospitalization costs for LRTI have comprehensively established total and component costs (inpatient services, length of stay, medication, and physician costs) of inpatient management.²⁻⁶ However, few analyses identify outpatient LRTI costs; these costs have been less rigorously evaluated, and no study has adequately established the contributions of each treatment component to total cost.^{2,3,6,7}

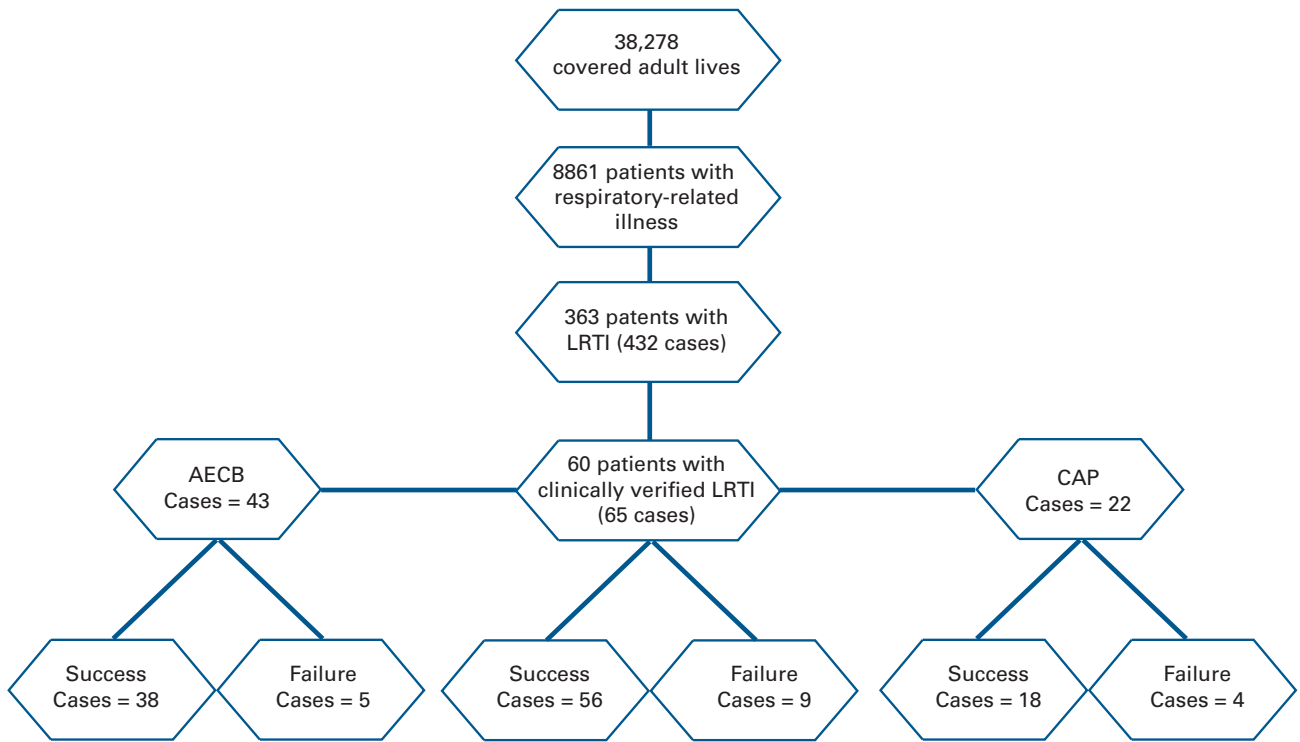
The expanding economic burden of LRTIs, encompassing increased healthcare access, advancing diagnostic technology, and new antibiotics, presents ongoing challenges for payers searching for cost-saving opportunities. Extrapolating from the 1980 National Medical Care Utilization and Expenditure Survey by applying medical consumer pricing for 2006, LRTIs would cost \$8.9 billion annually.^{1,8} However, in more recent analyses, acute exacerbation of chronic bronchitis (AECB) and community-acquired pneumonia (CAP) were found to cost \$1.96 billion and \$11.21 billion, respectively, in 2006 dollars for a total of \$13.17 billion.^{2,3} Clearly, emergence of the aforementioned expansions in healthcare access, technology, and antibiotics have increased healthcare costs and likely shifted payer costs toward outpatient expenditure. However, the extent to which each cost category (eg, initial and follow-up antibiotics, initial and follow-up visits, diagnostics, hospitalizations) contributes to total payer costs is not well described. Accordingly, a claims database analysis of a regional managed care organization (MCO) covering 38,278 adult lives was conducted to identify total and component treatment costs of AECB and CAP.

METHODS

This study involved a retrospective analysis of a regional MCO that identified adult outpatients (≥ 18 years of age)

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■ **Figure 1.** Participant Identification and Outcome Classification



LRTI indicates lower respiratory tract infection; AECB, acute exacerbation of chronic bronchitis; CAP, community-acquired pneumonia.

diagnosed with AECB or CAP. The protocol was approved by the University Health Sciences institutional review board; informed consent was not required. Primary care claims of MCO members from August 1, 2005, through July 31, 2006, were identified via the *International Classification of Diseases, 9th Revision, Clinical Modification*⁹ (ICD-9-CM) diagnostic coding for LRTI (the specific codes used are available from the authors). The electronic medical records of the identified members were reviewed to ensure clinical validity of the ICD-9-CM coding, and exclude proximity of previous LRTI.

Inclusion in the AECB cohort required documentation of chronic obstructive pulmonary disease (COPD) and the presence of at least 2 of 3 primary criteria: increased sputum purulence, increased sputum production, and increased dyspnea.¹⁰ Inclusion into the CAP cohort required the presence of at least 1 criterion from each of the following 3 categories: (1) radiologic evidence of a new or progressive infiltrate, consolidation, cavitation, or pleural effusion; (2) oral temperature >38°C (100.4°F) or <36.1°C (97°F), or leukocytosis (white blood cell count >10,000/mm³), or a pronounced left-shift (>10% immature leukocytes); (3) rales, dullness to percussion, or decreased breath sounds on auscultation.¹¹ Patients were excluded if they had ICD-9-CM documentation of an

outpatient LRTI within the previous 28 days or diagnosis-related group documentation of a LRTI-related hospitalization within the previous 3 months.

For patients meeting eligibility requirements, the following information was collected from the electronic medical record and database: medical record number, ICD-9-CM diagnostic code, primary care index date, initial and follow-up diagnostic tests, initial and follow-up antibiotic therapy, LRTI-related emergency room visits, hospitalizations, and treatment outcomes. Baseline characteristics were collected (ie, age, sex, antibiotic utilization within the preceding 3 months, concomitant conditions associated with LRTI).¹²⁻¹⁴

Patients were stratified by AECB or CAP and then categorized by treatment outcome. Successful outcome was denoted when additional antibiotic therapy, an LRTI-related emergency room visit, or hospitalization was not required within the 28-day period after the index visit. Total and component costs were determined to evaluate the cost of illness and calculate the proportion of antibiotic costs to total costs. Direct medical costs for outpatient healthcare resources in 2006 were furnished by the regional MCO, with the exception of hospitalization costs, which were extrapolated from previous epidemiologic data^{2,3} and the consumer price index of medical care.⁸

■ **Table 1.** Baseline Demographics*

Characteristic	AECB (n = 43)	CAP (n = 22)
Mean ± SD age, y	62.9 ± 14.3	50.8 ± 13.8
Female	22 (56)	12 (55)
Antibiotic use in previous 3 months, n[†]		
Cephalosporin	1	0
Clindamycin	1	1
Fluoroquinolone	7	5
Macrolide	5	2
None	20	14
Penicillin	4	4
Tetracycline	1	1
Sulfamethoxazole/trimethoprim	5	0
Concomitant conditions		
Alcoholism	1 (2)	1 (5)
Asthma	13 (30)	4 (18)
Coronary artery disease	5 (12)	1 (5)
Heart failure	6 (14)	1 (5)
Chronic obstructive pulmonary disease	43 (100)	7 (32)
Diabetes mellitus	8 (19)	2 (9)
Immunosuppression	1 (2)	2 (9)
Home oxygen	12 (28)	1 (5)
Tobacco utilization	24 (56)	14 (64)

*Values are number (percent) unless otherwise indicated.
[†]Three patients in the AECB cohort and 5 patients in the CAP cohort received multiple antibiotics. There were insufficient data for 2 AECB cases.
 AECB indicates acute exacerbation of chronic bronchitis; CAP, community-acquired pneumonia.

Statistical analyses were conducted for 2 endpoints in the AECB cohort: cost expenditures for successful and failed management, and treatment outcome with and without initial antibiotic therapy. A 2-sample *t* test was utilized to compare mean outcome costs for successful and failed management, and a χ^2 test was used to compare treatment outcomes in the presence or absence of initial antibiotic therapy. Statistical analyses were conducted using SYSTAT software, version 10 (SPSS Inc, Point Richmond, California). Cost-benefit analysis was conducted to assess the economic value of increased initial antibiotic expenditure.

RESULTS

From the database of 38,278 adults, 8861 patients were identified by 70 ICD-9-CM diagnostic codes pertaining to respiratory illness. We determined that 10 ICD-9-CM codes

would identify patients with the greatest potential to meet general inclusion and diagnostic criteria, resulting in 363 patients and 432 cases of LRTI. Of the 432 initial outpatient visits coded for AECB or CAP, 65 cases were validated from the electronic medical records. These comprised 60 patients; 43 cases of AECB in 39 patients and 22 cases of CAP in 22 patients; 1 patient was included in both the AECB and CAP cohorts (**Figure 1**). **Table 1** shows patient demographics, antibiotic history, and concomitant conditions for the 60 patients included in the study, categorized by AECB or CAP. Antibiotic utilization within the previous 3 months occurred in nearly 50% of the patients with LRTI; fluoroquinolones, β -lactams, macrolides, and sulfamethoxazole/trimethoprim were most frequently prescribed. The most frequently encountered concomitant conditions were COPD, tobacco utilization, asthma, home oxygen, and diabetes mellitus.

Antibiotic prescribing at the index visit was largely consistent with guidelines, as quinolones, macrolides, and β -lactams were the most frequently prescribed classes.¹⁵⁻¹⁷ Apparent success in the AECB cohort was seen in 38 of 43 cases (88.4%). Among the 34 patients

with AECB who received an antibiotic (79%), the success rate was 94%. Notably, 9 patients with AECB (21%) did not receive an antibiotic despite ICD-9-CM identification and clinical documentation sufficient to indicate acute exacerbation. The 67% success rate for these patients was less than that observed in the antibiotic-treated patients (*P* = .022). All patients in the CAP cohort received an antibiotic; the success rate was 81.8%. Quinolones were prescribed the most frequently, followed by macrolides and β -lactams.

Mean per-case and component costs for LRTI, AECB, and CAP are presented in **Table 2**. With only 1 hospitalization in the study sample, the data are right-skewed as is typical in outcome studies, resulting in large standard deviations. Therefore, mean total costs without hospitalization also are shown in **Table 2**. **Figure 2** shows costs for successful and failed management of AECB and CAP; **Table 3** breaks down component costs for the respective outcomes. The

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■ **Table 2.** Mean Per-case Costs for LRTI, AECB, and CAP

Treatment Component	Cost in 2006 Dollars, Mean ± SD				
	LRTI (n = 65)	LRTI-S (n = 56)	LRTI-F (n = 9)	CAP (n = 22)	AECB (n = 43)
Initial visit/diagnostics	185 ± 130	177 ± 117	238 ± 191	259 ± 181	147 ± 71
Initial antibiotic	68 ± 52	70 ± 51	60 ± 63	97 ± 40	54 ± 52
Follow-up visits/diagnostics	114 ± 215	100 ± 210	198 ± 240	188 ± 299	76 ± 147
Follow-up antibiotic	9 ± 30	0	66 ± 54	5 ± 16	11 ± 35
Hospitalization*	136 ± 1101	0	987 ± 2960	404 ± 1893	0
Total	513 ± 1232	347 ± 263	1548 ± 3205	953 ± 2063	288 ± 179
Total without hospitalization	376 ± 281	347 ± 263	562 ± 335	549 ± 360	288 ± 179

*\$8880 for 1 CAP hospitalization.
LRTI indicates lower respiratory tract infection; LRTI-S, lower respiratory tract infection–successful treatment; LRTI-F, lower respiratory tract infection–treatment failure; AECB, acute exacerbation of chronic bronchitis; CAP, community-acquired pneumonia.

largest component of payer expenditure was initial visit and diagnostic costs (36%), followed by hospitalization (27%; 1 CAP patient, no AECB patients), follow-up visit and diagnostic tests (22%), initial antibiotic therapy (13%), and follow-up antibiotic therapy (2%). In total, antibiotics accounted for 15% of payer costs. Within the AECB cohort, successfully treated patients were found to have a higher initial antibiotic expenditure (\$57) compared with patients who had failed management (\$27; $P = .027$). Cost-benefit analysis of mean initial antibiotic costs to mean total costs for successful and failed AECB management indicated a ratio of 3:1.

DISCUSSION

The burden of LRTI hospitalization costs, coincident with the prospect of expanding outpatient expenditures, creates an intriguing dilemma from the managed care payer perspective. Treatment pathways, formulary management, and reimbursement policies are axiomatically aimed at direct and future cost containment. Most often, medication costs are contained via formulary-mediated generic and/or therapeutic substitution; these agents are expected to result in clinical outcomes similar if not equal to those of more costly or branded agents. Likewise, initial visit and diagnostic costs are contained by treatment pathways and reimbursement policies that recognize the value of expedient diagnostic accuracy and clinical treatment. In maintaining a balance between confluent optimal outpatient management and payer expenditure alloca-

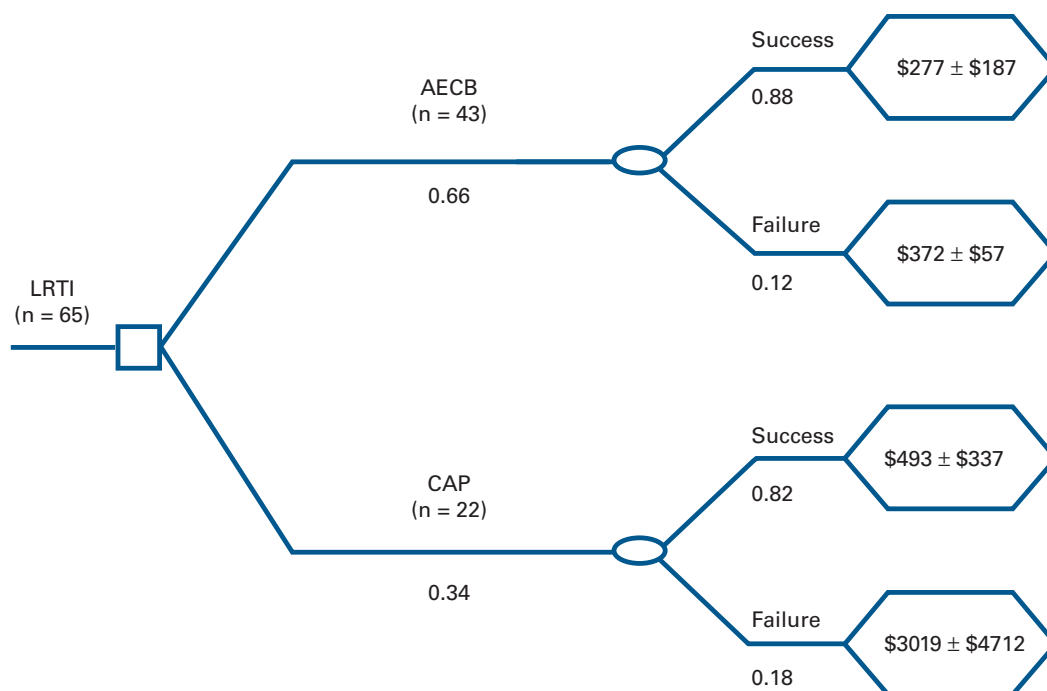
tion, it should be acknowledged that the specific timing and categorization of costs need to be considered in addition to total expenditure. In LRTI, the spectrum of costs includes initial visit and diagnostic tests, initial antibiotic therapy, follow-up visit and diagnostic measures, rescue antibiotic, emergency department visits, and hospitalizations.

From our analysis, it is apparent that the majority of costs are incurred from the initial visit and diagnostic tests (36%). The hospitalization contribution (27%) is likely an underestimate due to the dearth of hospitalizations in our study sample. However, it has been previously documented that 280,000 AECB and 1.1 million CAP patients are hospitalized annually in the United States (the mean hospitalization cost per patient was \$7171 and \$8880, respectively, in 2006 US dollars).^{2,3,8} The frequency and significant burden of hospitalization encountered within AECB and CAP populations accentuate the costs of treatment failure and overshadow the economic impact of drug-based cost-containment programs.

Cost-of-illness data broken down by components can identify whether treatment patterns are consistent with clinical expectations of patient outcomes and concordantly with quality of care. In our study, per-case payer expenditures for LRTI were \$1201 higher for patients failing therapy than for those successfully managed (\$1548 vs \$347). The costs for AECB patients failing therapy were \$95 higher than those for successfully managed patients, whereas CAP patients had a \$2525 cost differential. Once again, infrequent hospitalization in our study sample likely contributes to an underesti-

■ CLINICAL ■

■ **Figure 2.** Per-case Mean Outcome Costs ± SD for the Management of LRTI (2006 US Dollars)



LRTI indicates lower respiratory tract infection; AECB, acute exacerbation of chronic bronchitis; CAP, community-acquired pneumonia.

■ **Table 3.** Mean Per-case Costs by Treatment Outcome

Treatment Component	Cost in 2006 Dollars, Mean ± SD			
	CAP-S (n = 18)	CAP-F (n = 4)	AECB-S (n = 38)	AECB-F (n = 5)
Initial visit/diagnostics	237 ± 163	355 ± 248	148 ± 74	145 ± 49
Initial antibiotic	97 ± 40	100 ± 48	57 ± 51	27 ± 56
Follow-up visits/diagnostics	159 ± 294	316 ± 330	72 ± 153	104 ± 93
Follow-up antibiotic	0	27 ± 32	0	97 ± 50
Hospitalization*	0	2220 ± 4440	0	0
Total	493 ± 337	3019 ± 4712	277 ± 187	372 ± 57
Total without hospitalization	493 ± 337	798 ± 401	277 ± 187	372 ± 57

*\$8880 for 1 CAP hospitalization.
CAP-S indicates community-acquired pneumonia–successful treatment; CAP-F, community-acquired pneumonia–treatment failure; AECB-S, acute exacerbation of chronic bronchitis–successful treatment; AECB-F, acute exacerbation of bronchitis–treatment failure.

mate of the true differential between successful and failed management. When costs were assessed from a component perspective, significant benefit was observed with increased antibiotic expenditure in AECB patients. The benefit-cost ratio of 3:1 indicates for every additional dollar spent on ini-

tial antibiotic therapy, a return of \$3 on that investment would be produced.

It is particularly noteworthy that 21% of patients with AECB did not receive antibiotic therapy and had a significantly lower rate of success. From an economic perspective,

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there may be increased expenditure for these patients compared with antibiotic-treated patients due to the diminished success rate and subsequent necessity for follow-up visits, diagnostics, antibiotics, and potential hospitalizations. There is a growing demand for research regarding outcomes in the absence of antibiotic therapy in the AECB population. The future elucidation of these data in reference to component costs of AECB and CAP could establish the clinical and economic impact of therapeutically accurate bacterial identification in the outpatient setting.

Previous research identifying costs of outpatient LRTI have been primarily dependent on ICD-9-CM coding for patient identification. In this retrospective evaluation, there were multiple factors, in addition to the rigorous inclusion criteria, that limited the number of evaluable patients from an originally large population. The reduction in sample size was primarily attributable to the limited number of ICD-9-CM codes that would potentially allow for inclusion. The initial identification of approximately 1% of patients with LRTI is slightly less than the approximate 4% occurrence identified by the aforementioned epidemiologic data. Therefore, it is possible that the selected ICD-9-CM codes could have omitted some patients with true AECB or CAP. Second, lack of consistent documentation within the electronic medical record and poor correlation between ICD-9-CM coding and clinical symptoms limited enrollment (15% inclusion rate). The accuracy of diagnostic coding as a means for identifying patients is generally known to be suboptimal^{2,18} and is furthermore a significant barrier to applying pharmacoeconomic outcomes in real world scenarios. Accordingly, we felt it prudent to supplement ICD-9-CM coding with medical record review of clinical parameters to validate diagnosis. The disadvantage of this technique in our retrospective design was a significant reduction in sample size that limited both the assessment of potential treatment selection bias and generalizability to the greater population.

CONCLUSION

To our knowledge, this is the first study that combines ICD-9-CM codes and clinically verified cumulative and component resource utilization to assess successful and failed management of AECB and CAP in an outpatient population. Payer costs for LRTI averaged \$513 per case (\$288 AECB; \$953 CAP). Successfully managed CAP costs approximately twice as much as does successfully managed AECB. Clinical failure costs substantially more than success in cases of both

Take-away Points

Direct medical costs of acute exacerbation of chronic bronchitis (AECB) or community-acquired pneumonia (CAP) in an adult primary care population were determined from a managed care perspective.

- Compared with other costs of treatment, expenditures for antibiotics were nominal.
- Clinical failure cost substantially more than success in cases of both AECB and CAP.
- Identification of the component costs associated with outpatient treatment of lower respiratory tract infections (LRTIs) will influence ongoing research to establish the clinical and economic continuum of LRTIs, ultimately advancing clinical and policy decision making.

AECB and CAP. Initial visit and diagnostic tests, and hospitalizations contributed the greatest proportion of payer expenditure, followed by follow-up visits and diagnostics, and last by antibiotic therapy. A lower-than-anticipated frequency of hospitalization suggests there are likely higher per-case failure and differential outcome costs than those observed in our study sample; increased frequency of hospitalization would increase total costs and further diminish antibiotic contribution to total payer burden. It appears that there could be significant benefit in establishing a continuum that incorporates bacterial identification, antibiotic selection, and early and late treatment outcomes in the outpatient and inpatient settings to correlate with observed direct medical component costs. The establishment of such a continuum may serve to corroborate observations that favor greater initial antibiotic expenditure in the AECB population and to enable evaluation of the pharmacoeconomic impact of bacteriologic and clinical outcomes in the comprehensive management of LRTI.

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